Stoller
Hanford Office

DOE-EM/GJ621-2004

C4223
Log Data Report

Borehole Information:

Borehole: C4223			**Site:** 216-U-8 Crib		
Coordinates (WA State Plane)		**GWL (ft)[1]:** Dry		**GWL Date:**	03/16/2004
North	**East**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
Not Available	Not Available	March 2004	Not Available	55	Push Hole

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded steel	+0.5	6 5/8	5 1/2	9/16	+0.5	55

Borehole Notes:

Zero reference is the ground surface. The logging engineer used a caliper to determine the outside casing diameter. The caliper and casing stickup were both measured using a steel tape. Inside casing diameter was measured with a steel tape. All measurements were rounded to the nearest 1/16 in.

Logging Equipment Information:

Logging System:	Gamma 1G		**Type:** SGLS (35%) 34TP10967A
Calibration Date:	01/2004	**Calibration Reference:**	GJO-2004-597-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 1C		**Type:** High Rate Detector
Calibration Date:	04/2003	**Calibration Reference:**	GJO-2003-429-TAC
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5 / Repeat
Date	03/16/04	03/16/04	03/16/04	03/16/04	03/16/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	54.08	54.0	39.0	30.0	15.0
Finish Depth (ft)	54.08	40.0	31.0	0	10.0
Count Time (sec)	200	200	20	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	N/A[3]	1.0	1.0	1.0	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AG049CAB	AG049CAB	AG049CAB	AG049CAB	AG049CAB
Start File	AG049000	AG049001	AG049016	AG049025	AG049056

Log Run	1	2	3	4	5 / Repeat
Finish File	AG049000	AG049015	AG049024	AG049055	AG049061
Post-Verification	AG050CAA	AG050CAA	AG050CAA	AG050CAA	AG050CAA
Depth Return Error (in.)	N/A	N/A	N/A	0	0
Comments	Sonde tip is just touching bottom of borehole.	No fine-gain adjustment.	High rate zone - dead-time > 40%, counting time change.	No fine-gain adjustment.	Repeat section.

High Rate Logging System (HRLS) Log Run Information:

Log Run	1	2 / Repeat			
Date	03/24/04	03/24/04			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	42.0	35.0			
Finish Depth (ft)	30.0	32.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0 ft	1.0 ft			
ft/min	N/A	N/A			
Pre-Verification	AC092CAB	AC092CAB			
Start File	AC094000	AC094013			
Finish File	AC094012	AC094016			
Post-Verification	AC094CAA	AC094CAA			
Depth Return Error (in.)	N/A	0			
Comments	No fine-gain adjustment.	Repeat section.			

Logging Operation Notes:

Zero reference was ground surface. Logging was performed with a centralizer installed on the sonde. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 118. HRLS data were collected using Gamma 1C. Pre- and post-survey verification measurements employed the ^{137}Cs verifier with serial number 1013.

Analysis Notes:

Analyst:	Sobczyk	Date:	3/22/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of the day. All of the verification spectra were within the acceptance criteria. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were between 0.6 percent higher and 3.6 percent higher at the end of the day. Examinations of spectra indicate that the detector functioned normally during logging, and the spectra are accepted.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of the day. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS).

Log spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. The post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source files: G1GJan04.xls [SGLS] and G1CApr03.xls [HRLS]). Zero reference was the ground surface. Based on the field measurements, the casing configuration was assumed as one string of 6-in. casing with a thickness of 9/16 in. to 54.08 ft (total logging depth). A water correction was not required.

Using the SGLS, dead time greater than 40 percent was encountered in the interval from 31 to 40 ft. Data from this region are considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent. SGLS and HRLS dead time corrections were applied when dead time surpassed 10.5 percent.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs, ^{238}U, and ^{154}Eu were the man-made radionuclides detected in this borehole. ^{137}Cs was detected in the interval between 29 and 54 ft at concentrations ranging from the MDL (0.3 pCi/g) to 52,000 pCi/g. The maximum concentration of ^{137}Cs was measured at 33 ft. ^{238}U and ^{154}Eu were detected at 41 ft. ^{238}U, based on the 1001-keV photopeak, was detected with a concentration of 229 pCi/g. ^{154}Eu, based on the 1274 keV photopeak, was detected with a concentration of 2 pCi/g.

The plots of the repeat logs demonstrate reasonable repeatability of the HRLS and SGLS data. ^{137}Cs (662 keV) concentrations are comparable between the repeat and original HRLS log runs. The natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV are comparable between the repeat and original SGLS log runs.

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[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

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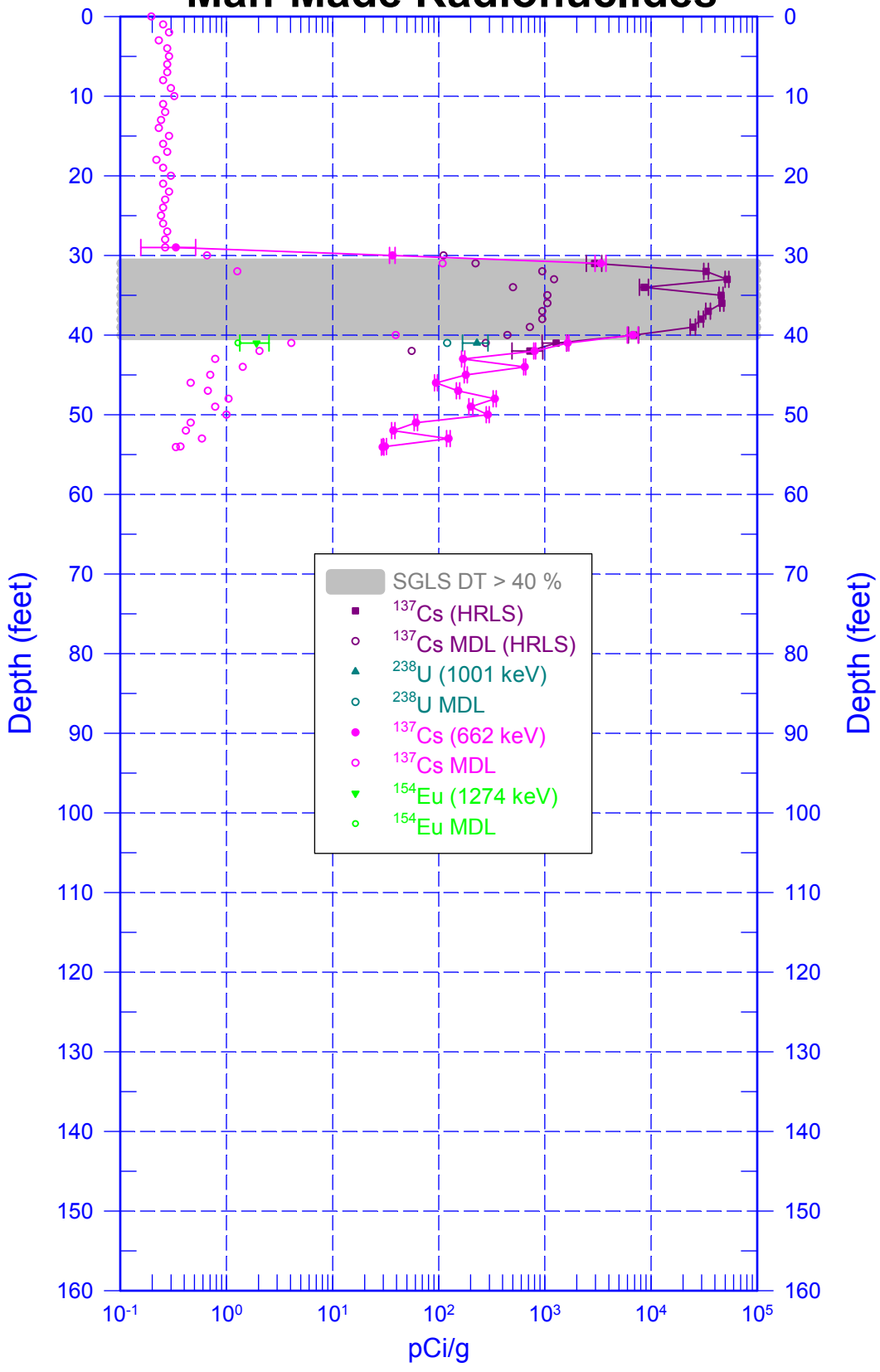
Man-Made Radionuclides



Zero Reference = Ground Surface

Date of Last Logging Run
3/24/2004

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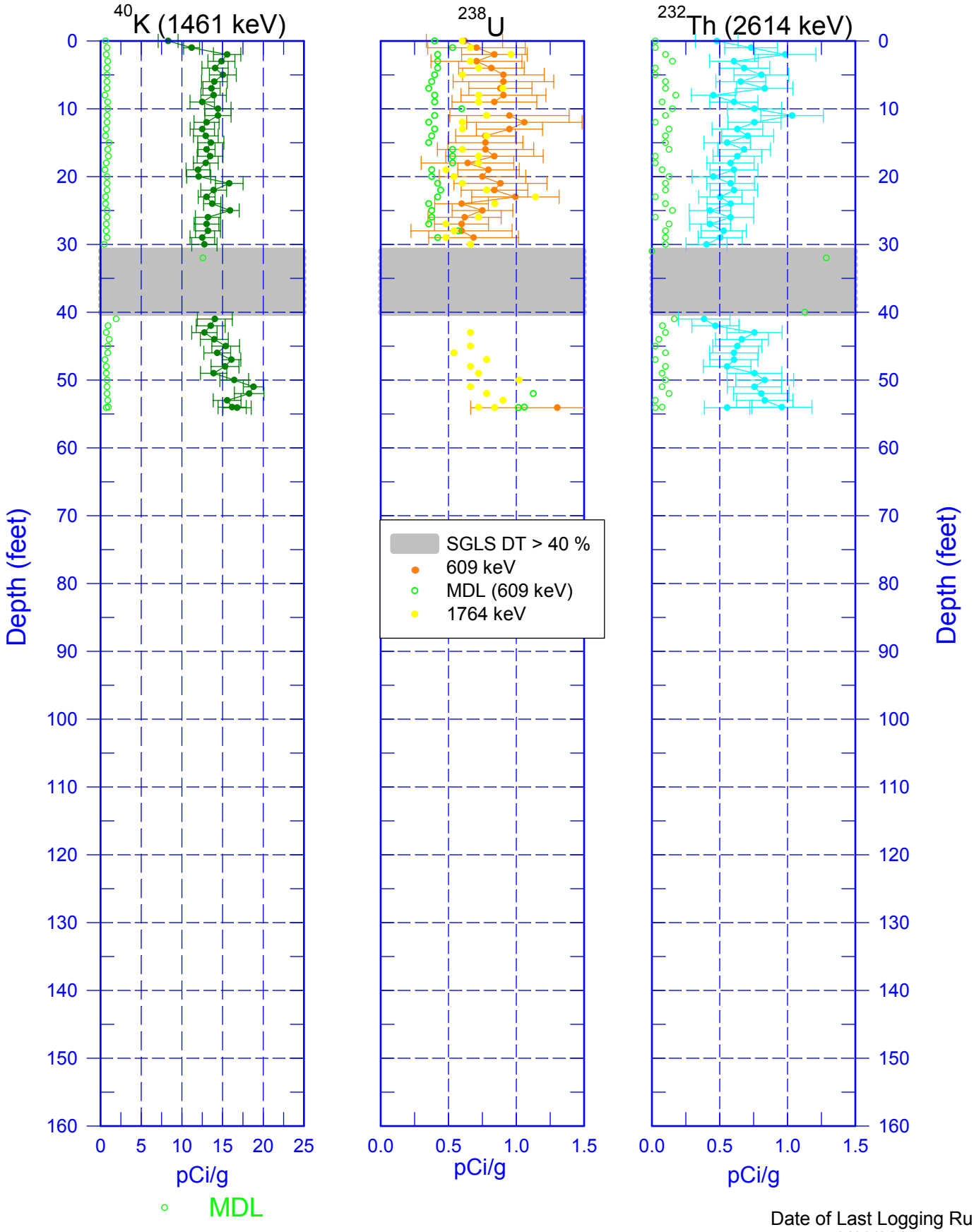
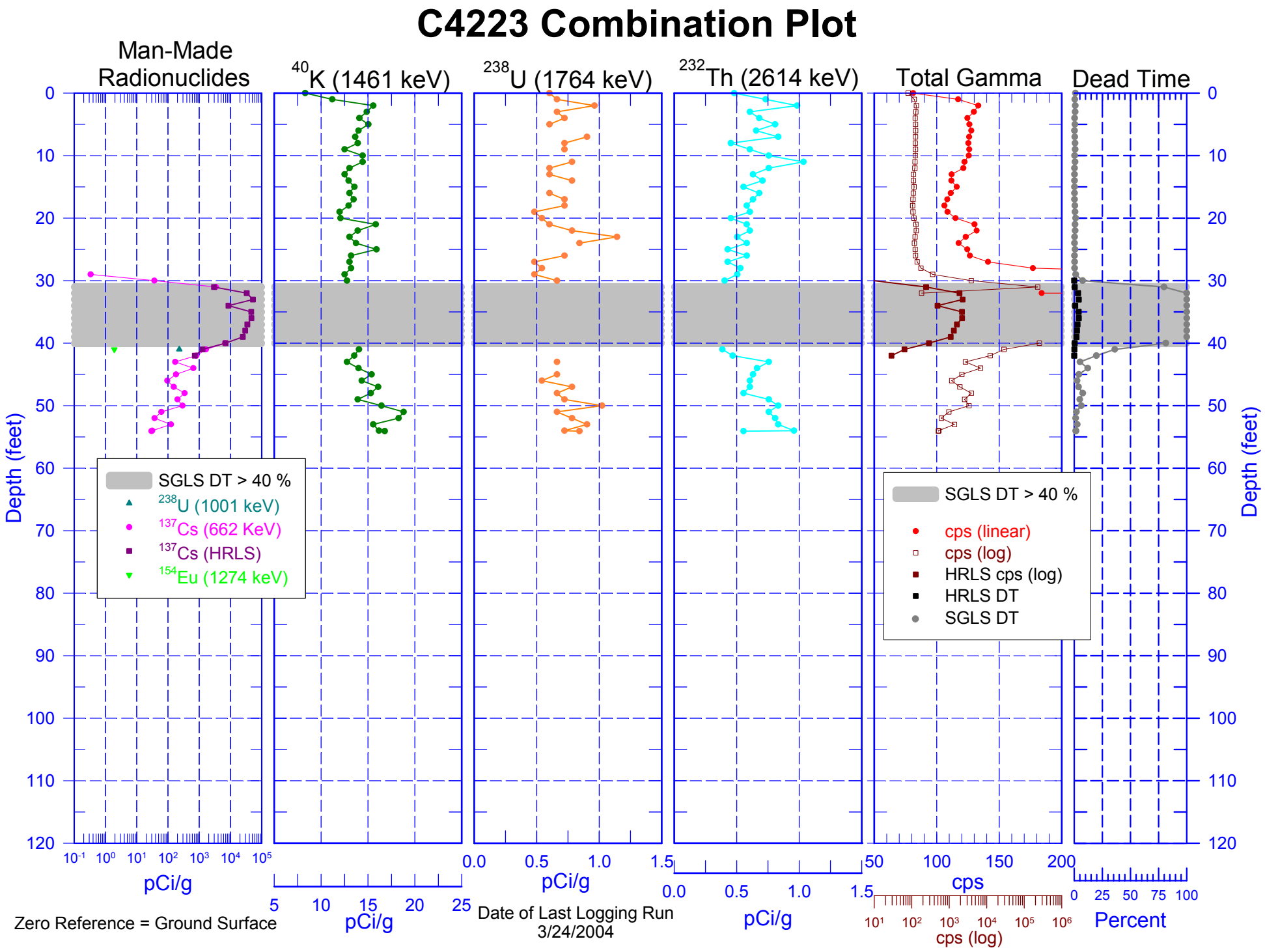
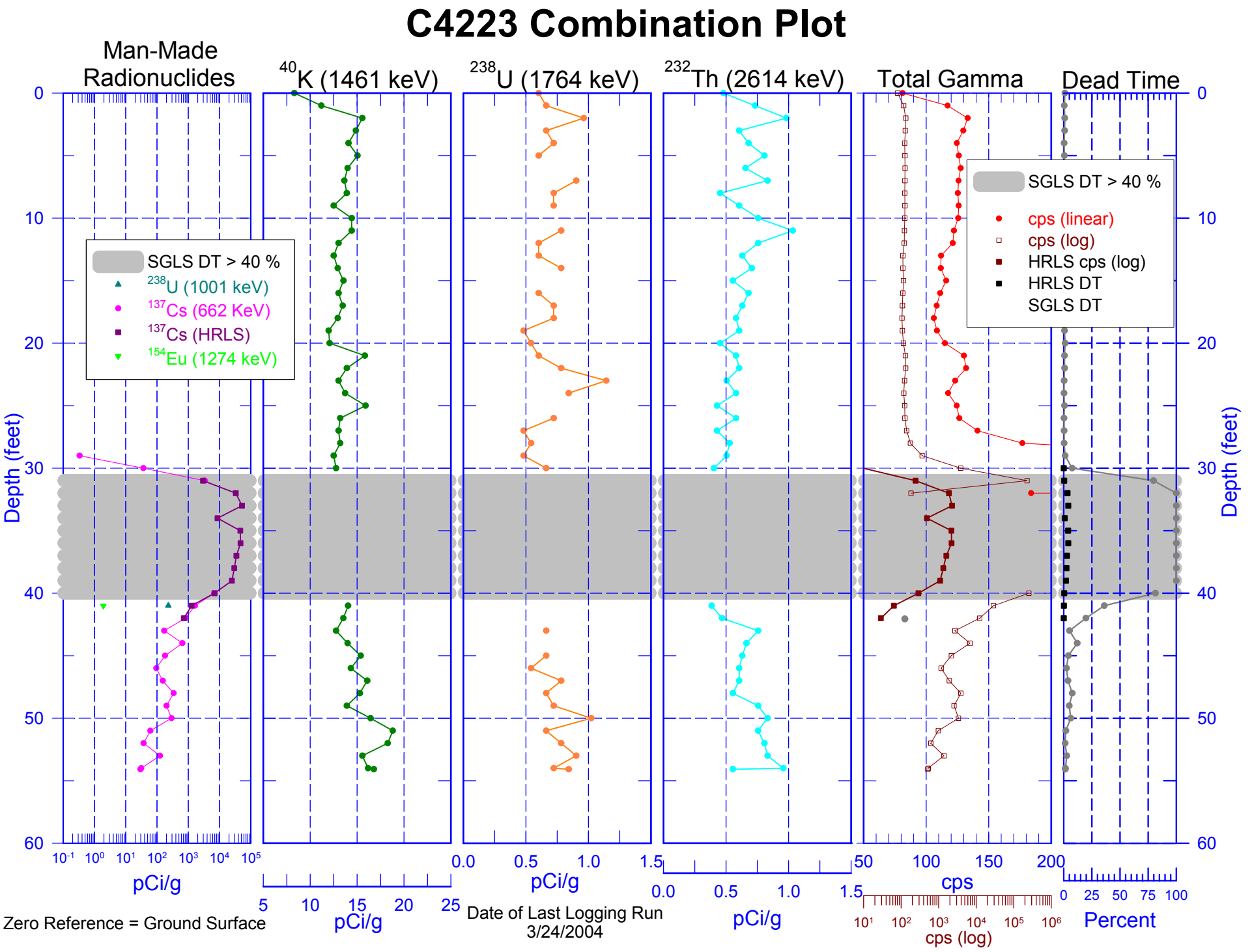
Natural Gamma Logs



Zero Reference = Ground Surface

Date of Last Logging Run
3/16/2004


C4223 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Dead Time
Depth (feet)
SGLS DT > 40 %
238U (1001 keV)
137Cs (662 KeV)
137Cs (HRLS)
154Eu (1274 keV)
cps (linear)
cps (log)
HRLS cps (log)
HRLS DT
SGLS DT
pCi/g
cps
cps (log)
Percent
Zero Reference = Ground Surface
Date of Last Logging Run
3/24/2004


C4223 Combination Plot
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Total Gamma
Dead Time
SGLS DT > 40 %
238U (1001 keV)
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137Cs (HRLS)
154Eu (1274 keV)
cps (linear)
cps (log)
HRLS cps (log)
HRLS DT
SGLS DT
Depth (feet)
pCi/g
cps
cps (log)
Percent
Zero Reference = Ground Surface
Date of Last Logging Run
3/24/2004

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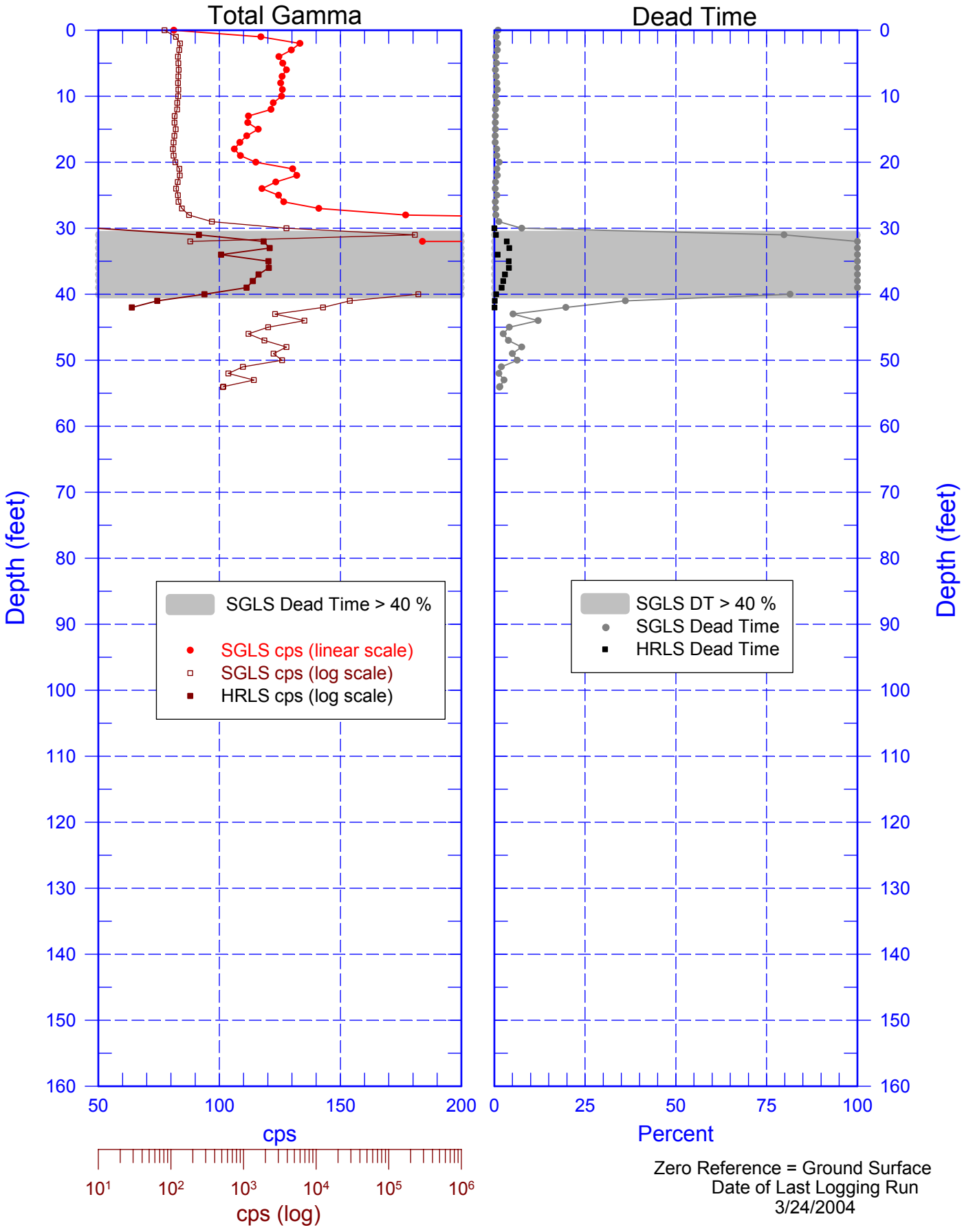
Total Gamma & Dead Time



Zero Reference = Ground Surface
Date of Last Logging Run
3/24/2004

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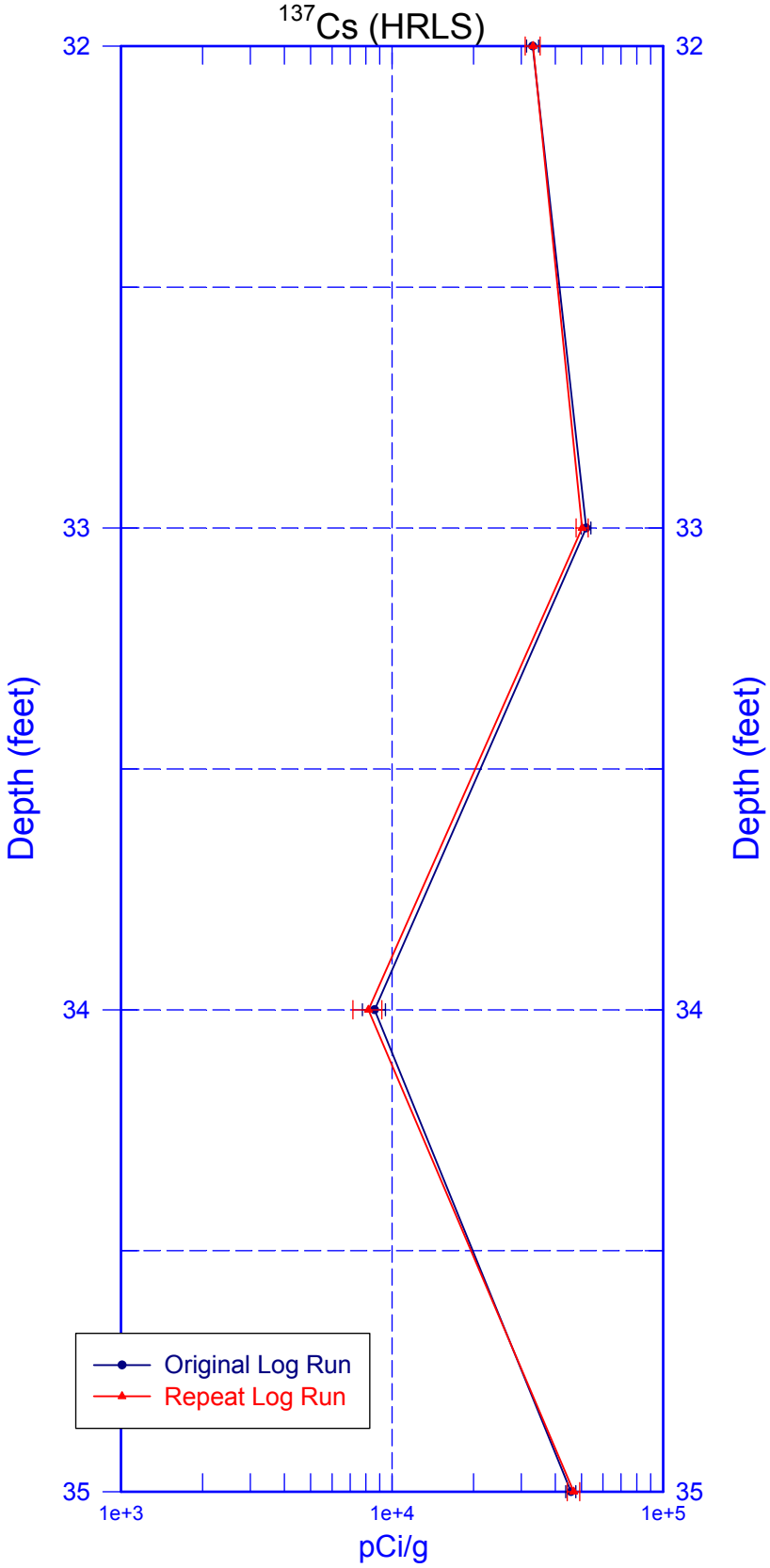
Rerun of Man-Made Radionuclides



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Rerun of Natural Gamma Logs (15.0 to 10.0 ft)